TECHNOLOGY FACT SHEET

FIELD EVALUATION OF AN INTEGRATED SPACE CONDITIONING/WATER HEATING HEAT PUMP SYSTEM

Buildings for the 21st Century

Buildings that are more energy-efficient, comfortable, and affordable…that's the goal of DOE's Office of Building Technology, State and Community Programs (BTS). To accelerate the development and wide application of energy efficiency measures, BTS:

- Conducts R&D on technologies and concepts for energy efficiency, working closely with the building industry and with manufacturers of materials, equipment, and appliances
- Promotes energy/money saving opportunities to both builders and buyers of homes and commercial buildings
- Works with State and local regulatory groups to improve building codes, appliance standards, and guidelines for efficient energy use
- Provides support and grants to States and communities for deployment of energy-efficient technologies and practices

Space heating, space cooling, and water heating are the largest end-users of energy in homes and small commercial buildings. The use of heat pump technology can help reduce the electric energy consumption for these applications. In 1997, the market for residential space conditioning heat pumps was 1.2 million units and it is growing by about 6 percent per year. For various reasons, the market for dedicated heat pump water heaters remains very small (<5,000/year). However, integrated heat pump products that combine space heating, space cooling, and water heating into a single device have recently become available for residential and small commercial buildings and they offer a number of advantages:

- Beneficial use of condenser heat during air conditioning operation
- Outside ambient air or indoor air can provide the energy source for hot water providing the highest overall efficiency for space conditioning and water heating
- Increased utilization of components
- Mid-season operation to provide dehumidifcation and efficient water heating

The U.S. Department of Energy (DOE) collaborated with the Alabama Power Company, Southern Company Services, and Oak Ridge National Laboratory in a cost-shared project to evaluate the field performance of a residential-sized, integrated heat pump water heating system. Investigators conducted a two-year study to evaluate Nordyne's PowerMiser, an air-to-air split system heat pump for space conditioning and water heating, whose three major components are shown in figure 1. The outdoor unit (fan-coil) is in the background; an indoor unit containing the compressor, water pump, and controls is in the foreground; and the indoor coil is in the middle unit. The hot water tank that is needed to complete the system is not pictured.

Figure 1. The Nordyne PowerMiser System

Project tasks included monitoring of the Nordyne's performance compared to the performance of conventional systems (heat pumps and conventional gas or electric water heaters) at specific field sites.

Results of the study shows that, although there was wide variability in the fraction of total hot water that was provided by the integrated system, depending on the hot water consumed and ambient outdoor

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temperatures, the integrated design could potentially meet up to 95 percent of the total hot water needs of a site. For houses with small hot water demands, the integrated system provided a smaller fraction of the total hot water demand, whereas for sites with large hot water demands, the integrated system carried most of the load. The integrated design met a greater fraction of a home's hot water need during the winter and during the summer – times when the system provided space conditioning as well as water heating.

A comparison was made between the efficiency of the integrated system and the efficiency of a house with an air-to-air heat pump and a conventional electric resistance water heater. Results showed the combined performance factor of a house with a 3-ton, 10 SEER integrated heat pump water heater to be higher than for a similar house fitted with an electric resistance water heater and at least a 16 SEER heat pump. In the space heating/water heating mode (i.e. in winter), the overall efficiency of the integrated heat pump water heater was higher than the combined efficiency of the most efficient heat pump and electric resistance water heater on today's market. See Figure 2.

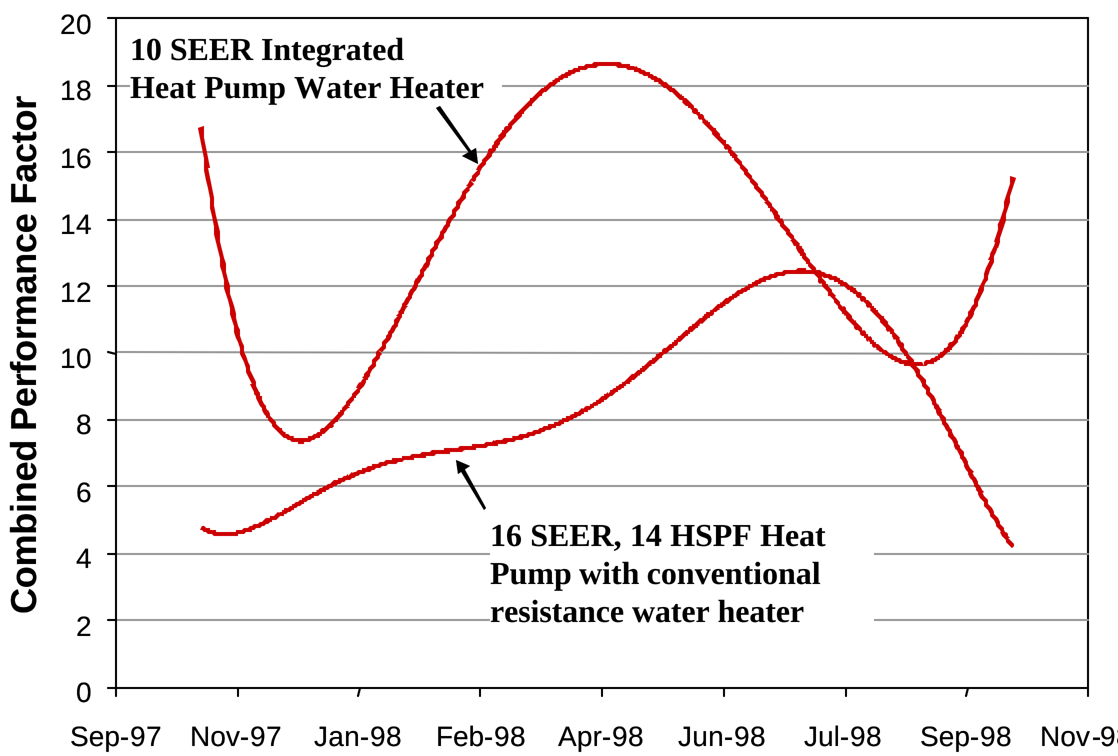

Figure 2. Powermiser system out-performed the best available conventional system